APPLICATION NOTE

Polycom® SoundStructure and Clockaudio® CH32 (Litetouch) Halo Ring and touch Pad Integration

This application note describes how to integrate the Clockaudio CH32 (Litetouch) Dual Colour Halo Ring and Touch Pad Switch with Polycom's SoundStructure products to support push-to-talk microphone applications.

The Litetouch Halo ring and touch pad is an accessory from Clockaudio that can be used with all Clockaudio through-table microphone products (Clock Audio). The Litetouch Halo ring and touch pad's touch-sensitive interface allows users to easily mute microphones and the green and red LED rings make it easy to see the status of microphones. By integrating the Litetouch Halo ring and touch pad with a SoundStructure system, the Litetouch Halo ring and touch pad is able to also control the mute of the HDX video system.

The SoundStructure configuration file described in this application note will use the SoundStructure device's general purpose input and output (GPIO) pins and SoundStructure events. This application note will design a project with eight microphones, a Polycom HDX video codec, and a stereo audio amplifier. The GPIO will be designed so that touching any Litetouch Halo ring and touch pad will toggle the mute state of all microphones. The Litetouch Halo ring and touch pads will light red when muted and green when unmuted. This behavior may be easily customized if the requirements for the installation differ from these assumptions. SoundStructure Studio 1.3 or higher must be used to create the configuration file and SoundStructure device firmware 1.3 or higher is required to implement this configuration.

Figure 1. Two Clockaudio Litetouch Halo ring and touch pads with through-table microphones with green (left) and red (right) LEDs illuminated (Clock Audio)

The project in this application note will be designed following these steps:

1. The baseline project with push-to-talk microphone options will be created. The built-in support for push-to-talk microphones will automatically create the appropriate push button and the red LED behavior.
2. The additional logic outputs required to support the green LED behavior will be added
3. The wiring of the GPIO inputs and outputs will be reviewed and adjusted if necessary

4. The additional SoundStructure events required to support the green LED behavior will be added
5. The configuration file will be saved, uploaded, and the behavior of the system will be verified

This resulting SoundStructure configuration file is available on the Polycom website.

SoundStructure Logic Connections

Each SoundStructure device has two rear-panel DB25 connectors and each connector supports 11 GPIO/logic inputs, 11 logic outputs, a signal ground, and a +5V supply. Each SoundStructure therefore supports a total of 22 logic inputs and 22 logic outputs. SoundStructure logic inputs have a default value of 1 (high) when the contact closure is open, and have a value of 0 (low) when the contact closure is closed and tied to ground. SoundStructure logic outputs are open collector circuits that when set to 1 connect the logic pin to ground (allowing current to flow) and otherwise act as open circuits (no current flows).

Within SoundStructure Studio, logic input and output pins are defined as virtual channels. This means that there is a virtual channel name associated with each logic pin and that virtual channel name is used when programming the behavior of the logic pin and querying the status of logic pins associated with the underlying physical input or output connection (Polycom).

Within the SoundStructure Studio software environment, there is a wiring page that shows all the logic input and output pins as shown in Figure 2. In this figure, logic input pins 1 through 22 are shown expanded and the logic output pins are shown collapsed under the Digital GPIO Out area.

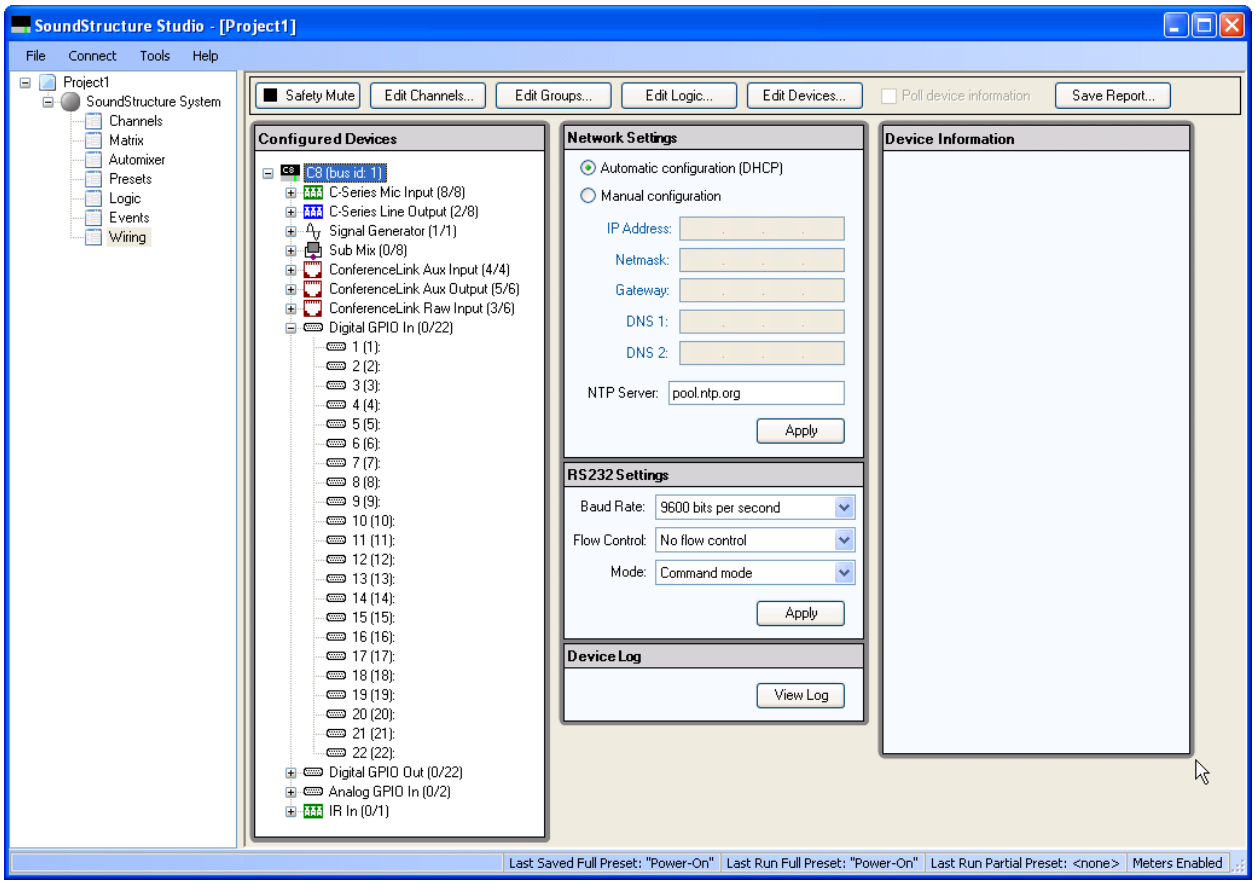
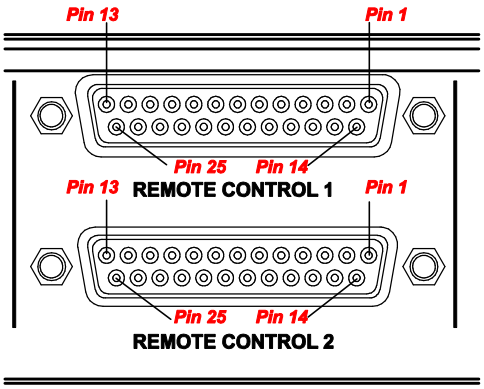


Figure 2. Example wiring page showing the 22 logic inputs for a particular SoundStructure device

The 22 logic input and output pins are associated with the physical logic pin connections on the connectors as shown in Figure 3. Each DB25 connector has 11 digital logic inputs and 11 digital logic outputs. In Figure 3, logic input 1 (pin 14 of the top DB25 connector) corresponds to the first logic input pin on the wiring page, logic input 2 (pin 15 on the top DB25 connector) corresponds to the second logic input pin on the wiring page, etc.



SoundStructure Logic			
Pin	**Signal**	**Pin**	**Signal**
REMOTE CONTROL 1			
1	+5V	14	Logic input 1
2	Logic output 1	15	Logic input 2
3	Logic output 2	16	Logic input 3
4	Logic output 3	17	Logic input 4
5	Logic output 4	18	Logic input 5
6	Logic output 5	19	Logic input 6
7	Logic output 6	20	Logic input 7
8	Logic output 7	21	Logic input 8
9	Logic output 8	22	Logic input 9
10	Logic output 9	23	Logic input 10
11	Logic output 10	24	Logic input 11
12	Logic output 11	25	Ground
13	Analog gain input 1		
REMOTE CONTROL 2			
1	+5V	14	Logic input 12
2	Logic output 12	15	Logic input 13
3	Logic output 13	16	Logic input 14
4	Logic output 14	17	Logic input 15
5	Logic output 15	18	Logic input 16
6	Logic output 16	19	Logic input 17
7	Logic output 17	20	Logic input 18
8	Logic output 18	21	Logic input 19
9	Logic output 19	22	Logic input 20
10	Logic output 20	23	Logic input 21
11	Logic output 21	24	Logic input 22
12	Logic output 22	25	Ground
13	Analog gain input 2		

Figure 3. Pin out of the two rear panel DB25 connectors on each SoundStructure device

CH32 HALO Connections to SoundStructure

Each Litetouch Halo ring and touch pad requires five wires for supporting the logic input and logic output applications and utilizes two logic output pins and one logic input pin. The Litetouch Halo ring and touch pad's have an RJ45 connection and the wiring is summarized in Table 1.

Table 1. Physical Connections to the Litetouch Halo ring and touch pad.

RJ45 Connection	Litetouch Halo ring and touch pad Connector	SoundStructure Connection
Brown	+12V	None
Blue	Ground	Pin 25 (logic ground)
Red	Red LED logic input connection	A logic output pin
Green	Green LED logic	A logic output pin

	connection	
Yellow	Touch sensitive logic switch output	A logic input pin

Connect each Litetouch Halo ring and touch pad to the SoundStructure device as shown in *Figure 4* utilizing two logic output pins and one logic input pin per Litetouch Halo ring and touch pad.

An external 12V power supply is required and should be sized appropriately to supply 40mA at 12V for each Litetouch Halo ring and touch pad in the system (Clock Audio). A power supply that provides 400mA of current at 12V will support 10 Litetouch Halo ring and touch pads.

Each SoundStructure device will support 11 Litetouch Halo ring and touch pads since each Litetouch Halo ring and touch pad requires 2 logic outputs and 1 logic input to operate the green and red LED rings independently.

Note: *For proper operation the negative lead of the power supply must be connected to the ground pin (physical pin 25) of either DB25 connector on the SoundStructure device as shown in Figure 4.*

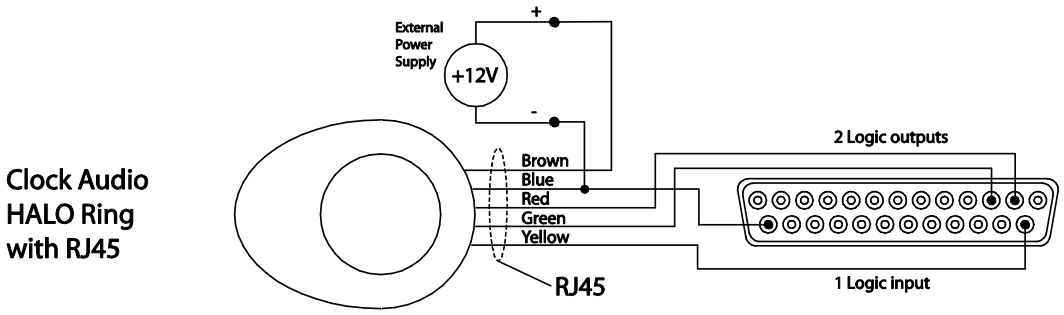


Figure 4. Example of wiring of a *Litetouch Halo ring and touch pad* to a SoundStructure device connected to logic output 1 (physical pin 2) and logic output 2 (physical pin 3) and logic input 1 (physical pin 14). Each *Litetouch Halo ring and touch pad* requires 2 logic outputs and one logic input pin from the SoundStructure device

SoundStructure Studio Configuration

As described earlier, the SoundStructure configuration file for this application note assumes that regardless of the number of Litetouch Halo ring and touch pads, the desired behavior is to have any of the Litetouch Halo ring and touch pads mute all the microphones in the system. When the microphones are muted, the red LEDs will be illuminated and when the microphones are unmuted the green LEDs will be illuminated. Other operational modes can be supported by modifying the underlying SoundStructure events. See (Polycom) for additional training streams on how to create SoundStructure configuration files that support push-to-talk microphones.

Defining SoundStructure logic input and output pins

The easiest way to add support for Litetouch Halo ring and touch pads is to create a new SoundStructure configuration file and then customize the logic outputs and events to support both the green and red LED behavior.

To create this project, select New Project from the SoundStructure Studio File menu. SoundStructure Studio version 1.3 or higher is required.

As highlighted in Figure 5, select Microphone (1) and then Table (2), the number of microphones that will use Litetouch Halo ring and touch pads (3), select the Logic Input Mode to be Toggle all mics mute (4) and the Logic output Mode to Activate on mute (5), and finally click Add (6). Since the logic output will be active when muted, these logic output pins are the RED led's. The result of clicking Add is shown in.

To only toggle the mute of the particular microphone, and not all microphones, in step 4, select Toggle Mic Mute instead of Toggle All mics mute.

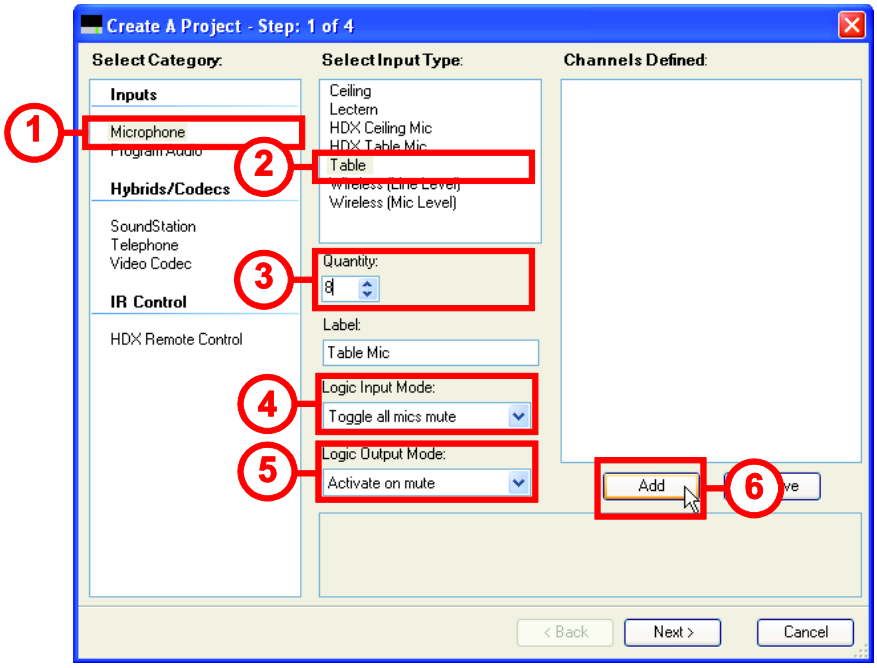


Figure 5. Options required in Step 1 of creating a project to support Clockaudio Litetouch Halo ring and touch pads. These options will use one logic input pin and one logic output pin per microphone

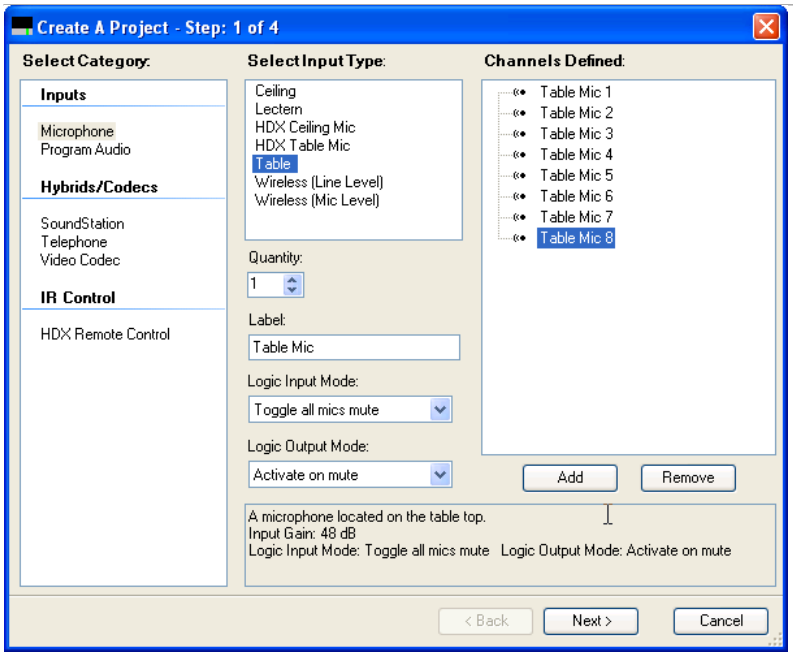


Figure 6. The result of adding the 8 table top microphones in Figure 5

Complete the project with the other audio inputs (in this case an HDX video codec) and the desired output sources (in this case, an audio amplifier) and click **Finish** to complete the project. In this example, an HDX video codec and a stereo audio amplifier are added to the system. Examples of how to create SoundStructure configuration files may be found in (Polycom) and (Polycom).

Once the project has been created, navigate to the events page to see the events that were automatically created for this project as shown in Figure 6. For more information about events and examples of how to use and create events, see the SoundStructure v1.3 Primer (Polycom).

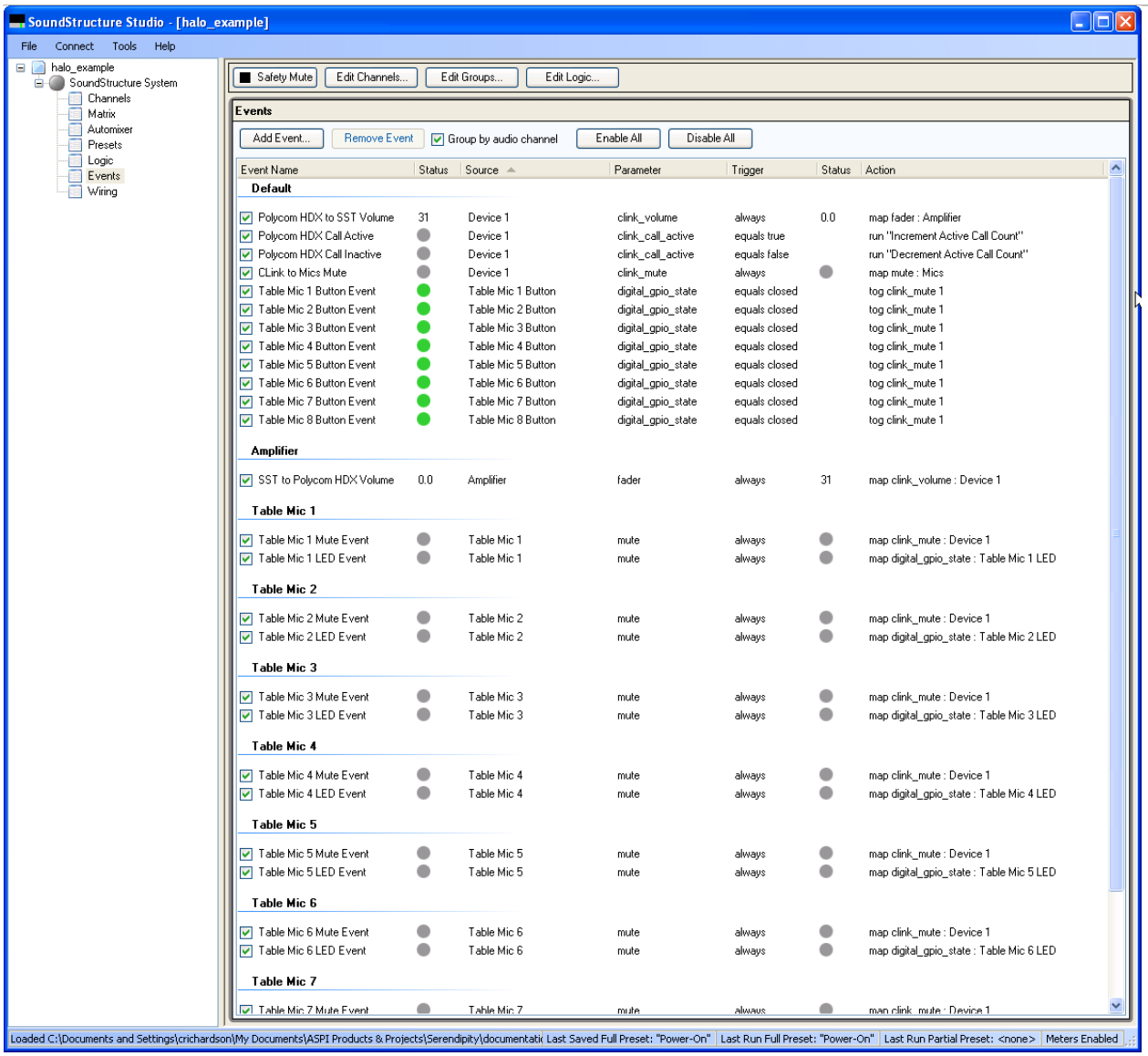


Figure 7. The SoundStructure Studio events page shows all the events that were generated for this project

In Figure 7, we see there are three events that were automatically created for each microphone. These events allow the logic input from the microphone to toggle the mute state and connect the red LED to the mute status. These three events are described in Table 2.

Table 2. SoundStructure default events for Table Mic 1

Event Name	Purpose
Table Mic 1 Button Event	Toggles the value of the clink_mute parameter when the logic input pin "Table Mic 1 Button" is closed.

Table Mic 1 Mute Event	Maps the mute state of Table Mic 1 to the value of the clink_mute parameter. If clink_mute is set to 1, Table Mic 1 will be muted.
Table Mic 1 LED Event	Maps the mute state of Table Mic 1 to the value of the logic output "Table Mic 3 LED". If mute is true then the logic output value is set to true which will turn on the LED. If mute is false then the logic output value is set to false which will turn off the LED.

To complete this configuration file, a green LED event must be created for each microphone to drive the green LED when the microphone is unmuted. Before creating these events for the green LEDs, it is first necessary to add the eight logic output pins – one for each of the green LEDs.

Adding Logic Output Pins

The logic page within SoundStructure studio makes it easy to add eight logic output pins starting with clicking the Edit Logic button. As shown in Figure 8, select Digital Logic Output (1), and then Digital Logic Output (2), adjust the quantity to 8 (3), select a meaningful label (4), and select Add (5). Clicking Add will define the new logic output pins as shown in Figure 9.

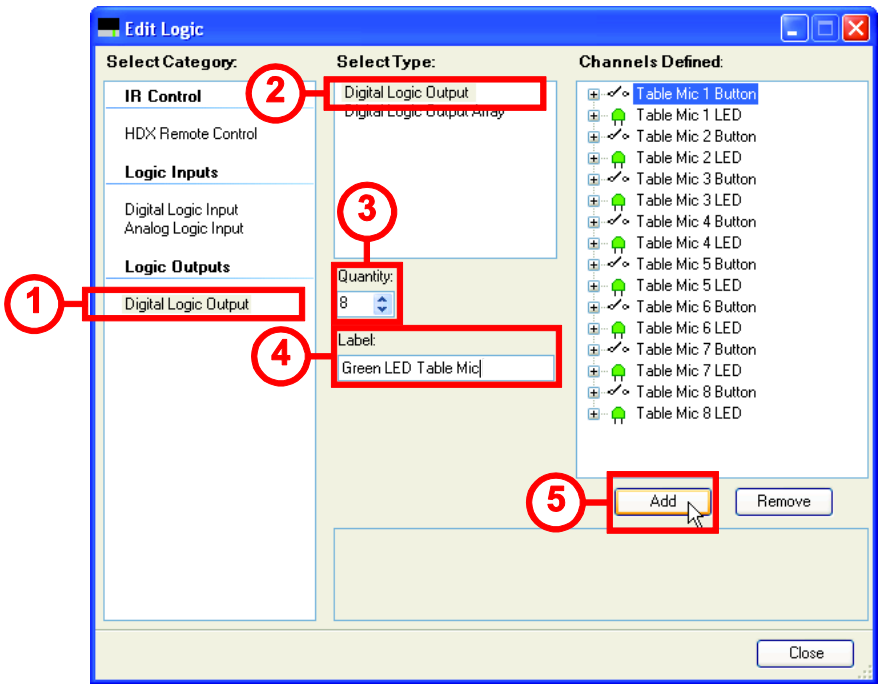


Figure 8. Adding the logic outputs for the green LEDs

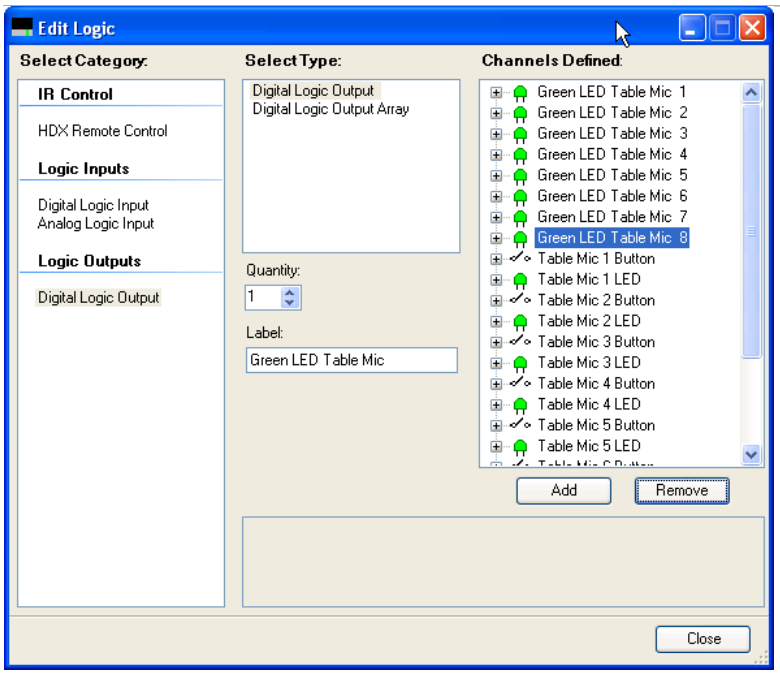


Figure 9. Resulting logic definitions after the green LED logic outputs have been added

Once the additional logic output pins for the green LEDs are defined, confirm the wiring of the logic inputs and outputs on SoundStructure Studio's wiring page and, if necessary, click and drag the logic pins to the appropriate logic input and output locations that match the desired physical wiring of the DB25 connector. The current wiring of this project is shown in Figure 10 where "Table Mic 1 Button" is the virtual channel name for the first logic input pin (physical pin 14 on the top DB25 connector) and "Table Mic 1 LED" is the virtual channel name for the first logic output pin (physical pin 2 on the top DB25 connector).

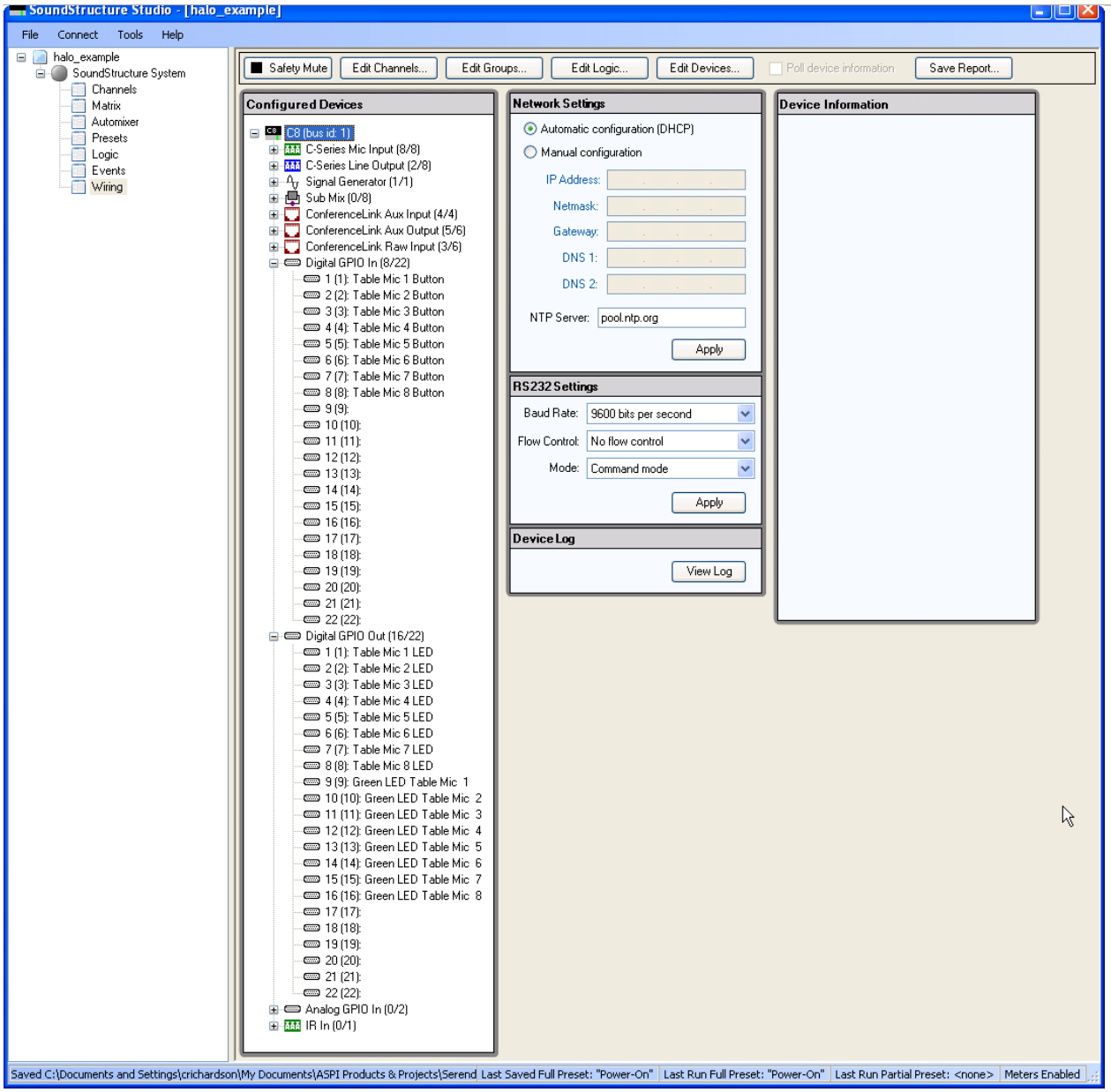


Figure 10. Wiring page for the logic inputs and outputs in this project. The wiring may be changed to match physical wiring by clicking and dragging the logic inputs or outputs to other pin locations

Creating the Green LED Events

Once the logic output pins required for the green LEDs have been added, the next step is to create the events that create the desired behavior of illuminating when the microphone is unmuted.

To add the required events, navigate to the events page and select Add Event. As shown in Figure 11, we'll define the first event for Table Mic 1, and will name the event "Table Mic 1 Green LED Event" (1). The source for this event will be the mute parameter for Table Mic 1 (2), the trigger will be Always (3), and the action will be to map the invert of the mute state to the new logic output pin (4). The invert box must be checked to allow the green LED to be active (logic output value = 1) when the system is not muted (clink_mute value = 0) and vice versa. Once these options are selected, click Add to create the event.

The green LED events are very similar to the existing LED events with the exception that the invert option is selected. This will ensure that the LED status will reflect the true mute state of the individual microphones and consequently the green and red LEDs won't be illuminated the same time.

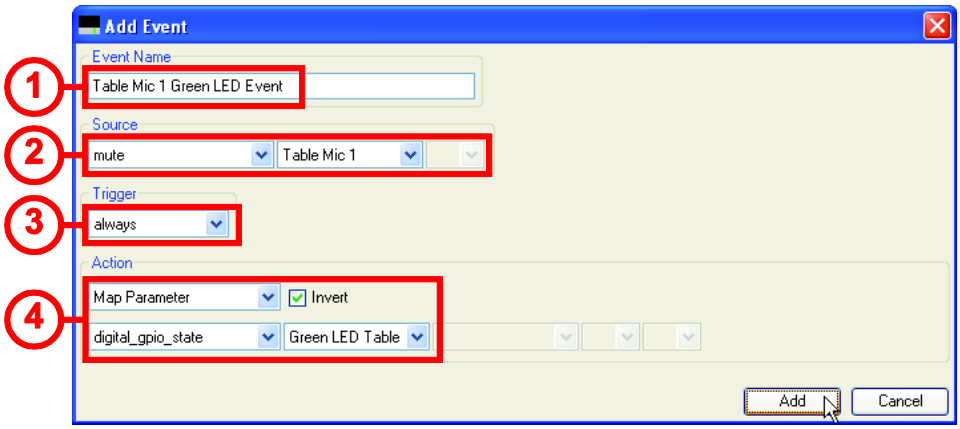


Figure 11. Defining the green LED event for Table Mic 1 based on the mute state of the microphone. Note the invert option is selected so that the green LED only lights up when the microphones are not muted

Each microphone must have a green LED event defined. This requires creating seven more events similar to the event in Figure 11 for each of Table Mics 2 through 8. In the action for each of these events, use the Green LED Table Mic 2 through 8 respectively.

Once the events have been added, the result will appear as shown in Figure 12 with similar events for microphones 1 through 8.

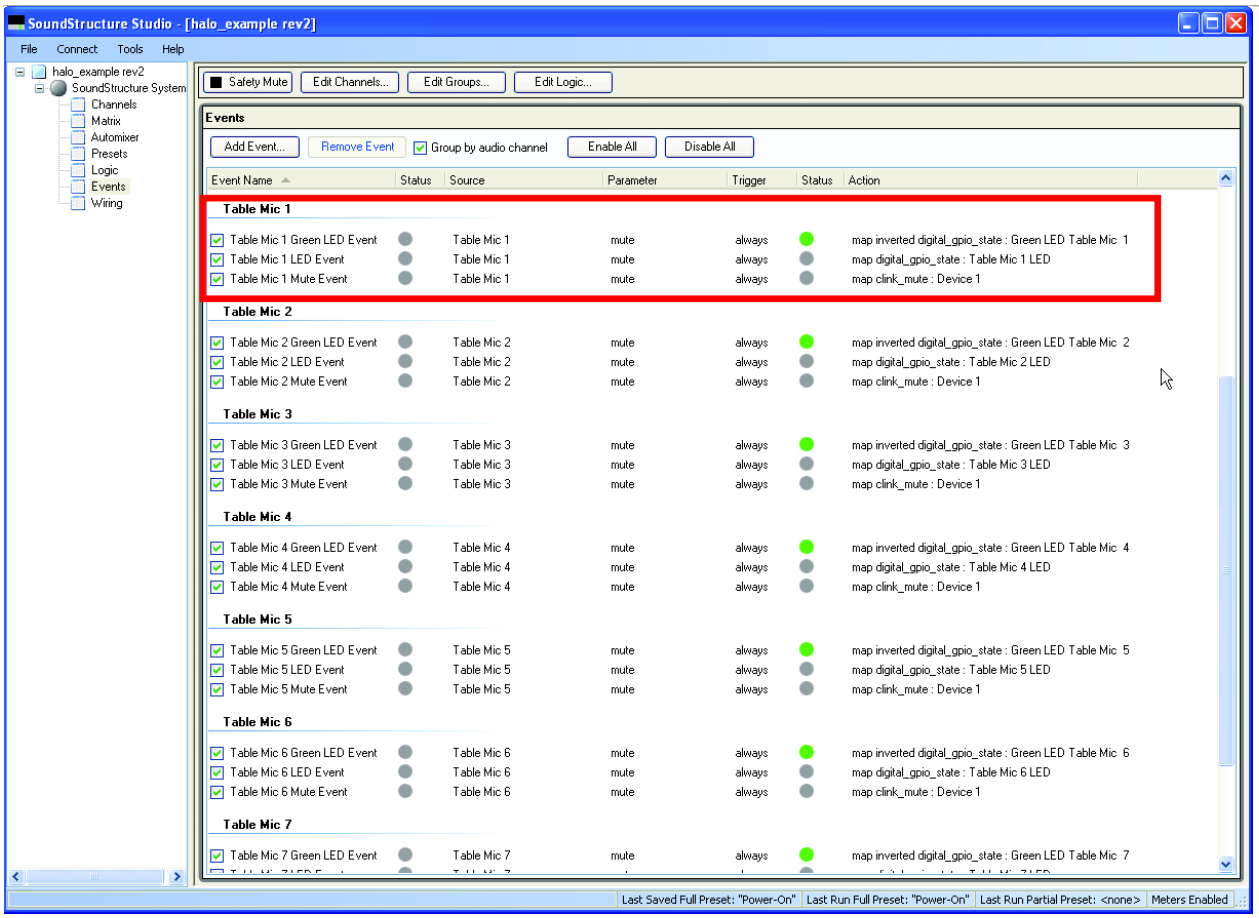


Figure 12. Resulting events that support the green LEDs with the events for Table Mic 1 highlighted. All eight microphones have similar events

These three events operate as follows:

- Table Mic 1 Mute Event: If the mute state of Table Mic 1 changes, this will change the state of the parameter clink_mute which through the Clink to Mics Mute event will in turn change the state of the mute of "Mics" – causing all microphones to have the same mute state.
- Table Mic 1 LED Event: If Table Mic 1 is muted, then the LED will be illuminated
- Table Mic 1 Green LED Event: If Table Mic 1 is unmuted, then the green LED will be illuminated.

Once these events have been added, use the File Save option to save the configuration settings to disk.

***Note**: Save the configuration file settings to disk to ensure the settings are preserved.*

Verifying the Operation of the System

To confirm the operation of the system, ensure the logic pins are wired as specified on the wiring page, and then upload the resulting configuration file to a SoundStructure device.

Once the logic definitions and events have been created for the Litetouch Halo ring and touch pads, the following steps are required to complete the system:

1. Connect the input and output audio channels to the SoundStructure system according to the wiring page
2. Connect the Litetouch Halo ring and touch pads to the proper logic input and output pins on the SoundStructure device. See the example wiring for one Litetouch Halo ring and touch pad in *Figure 4*. Each Litetouch Halo ring and touch pad requires its own logic input and two logic output pins.
3. Upload the SoundStructure configuration file to the SoundStructure system

Once the system has been wired and the configuration file uploaded, the system may be tested by touching the Litetouch Halo ring and touch pad on any microphone. Assuming the system was unmuted initially (clink_mute set to 0), touching the Litetouch Halo ring and touch pad will cause the logic input event associated with that microphone to toggle the state of the parameter clink_mute, setting the clink_mute parameter to 1. The Clink to Mics Mute event will then mute all the microphones in the Mics group. As each microphone has been muted, the red LEDs on each microphone will be turned on and the green LEDs will be turned off.

The way the events are defined in this example, independently setting the mute state for any microphone within SoundStructure Studio, or through a control system, will also change the status of the Litetouch Halo ring and touch pads. For example, sending the mute command:

set mute "Table Mic 1" 1

will result in the same behavior as touching the Litetouch Halo ring and touch pad – the mute state of the entire system will be set and turn on the red LEDs. Touching the Litetouch Halo ring and touch pad again will then cause the microphones to become unmuted which in turn will turn off the red LEDs and turn on the green LEDs.

Using API Commands to Turn on or off all LEDs at Once

For applications where it is desired to turn on or off all LEDs at once, for example turning off the LEDs when the room is empty, it is possible to use the SoundStructure API commands directly. To simplify turning on or off all the LEDs at once, virtual channel groups of logic pins may be created. The result of creating a virtual channel group of the logic output pins associated with the red LEDs and a second group associated with the green LEDs is shown in Figure 13. To turn off all the LEDs at once, a control system would use the commands:

set digital_gpio_state "RED LED Group" 0

and

set digital_gpio_state "Green LED Group" 0

Once the LEDs are turned off, touching any of the Litetouch Halo ring and touch pads will toggle the mute state and consequently trigger the events that will set the logic output pins to indicate the current mute state of the microphones. For more information on creating virtual channel groups, see (Polycom).

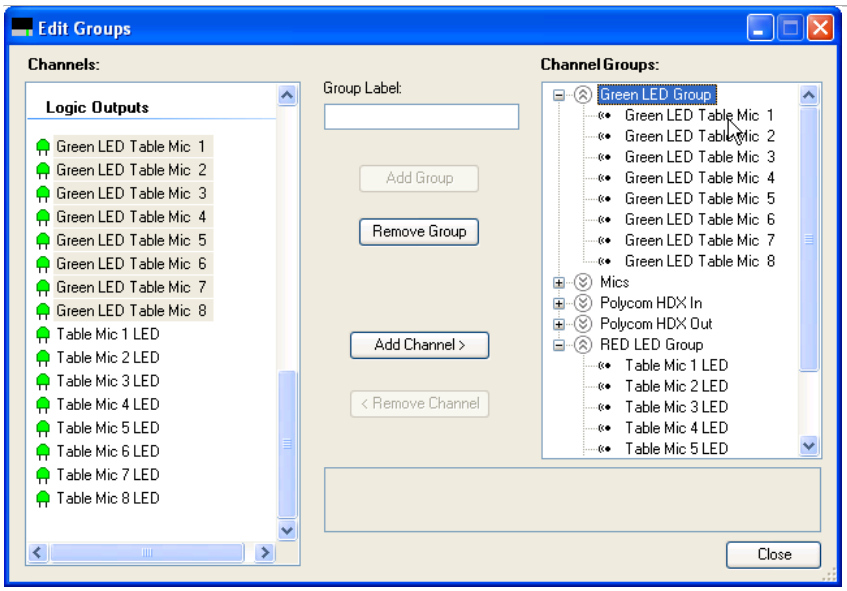


Figure 13. Using the Edit Groups button, it is possible to create a new virtual channel group the RED and green LEDs

Summary

This application note detailed the use the Clockaudio CH32 Litetouch Halo ring and touch pads with SoundStructure using SoundStructure device's GPIO inputs and outputs and events. This SoundStructure configuration file was designed so that touching any Litetouch Halo ring and touch pad would toggle the mute state of all the microphones. Due to the flexibility of the SoundStructure events, it is possible to design the system to support other operating modes such as muting individual microphones independently, tying the green or red LEDs to microphone gating information, tying the green or red LEDs to microphone signal activity, and more.

References

Clock Audio. (n.d.). Retrieved from http://www.clockaudio.com

Clock Audio. (n.d.). Retrieved from http://www.clockaudio.com/tabid/852/Default.aspx

Clock Audio. (n.d.). *CH32 Specification Sheet*. Retrieved from http://www.clockaudio.com/Portals/5/images/technical/ch32_spec.pdf

Polycom. (n.d.). *SoundStructure C-series Support.* Retrieved from http://www.polycom.com/global/documents/support/setup_maintenance/products/voice/SoundStructure_1_3_Primer.pdf

Polycom. *SoundStructure Design Guide.*

Polycom. (n.d.). *SoundStructure Training.* Retrieved from http://www.polycom.com/support/voice/soundstructure/soundstructure_training.html